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SPACE SHUTTLE
PHASE B FINAL REPORT

Volume III
Plans summary

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(NASA-CR-134358) SPACE SHUTTLE PHASE B. VOLUME 3: PLANS SUMMARY Final Report (North American Rockwell Corp.) 14 p

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1.0 INTRODUCTION

The Phase B shuttle program study involved accomplishment of Phase C/D program acquisition planning in accordance with the Program Statement of Work. This planning resulted in the preparation of a series of individual acquisition plans, listed below, which set forth the basic requirements necessary to conduct a Phase C/D program from preliminary design through operational employment of the shuttle system.

Program Management Plan
Engineering and Development Plan
Operations Plan
Facilities Utilization and Manufacturing Plan
Preliminary Test Plan
Logistics and Maintenance Plan
Cost and Schedule Estimates Plan

These individual plans produced during Phase B and submitted as deliverable contract data items are summarized in this report. A brief description of the development and integration process used to produce these plans and their interrelationship is presented, together with a narrative description of each plan.

2.0 DEVELOPMENT AND INTEGRATION

The Phase B study program was conducted in three major increments: (1) concept evaluation and configuration definition, (2) system and subsystem definition, and (3) program definition and documentation. Phase C/D program acquisition planning has been an integral, parallel effort throughout these phases, culminating in preparation of the required plans described herein. These documents evolved through the process shown in Figure 2-1.

The plans development effort was specifically concerned with the interrelationships of the various plans. The general interrelationship starts with the Program Management Plan setting the framework of organization and management systems within which all program effort would be accomplished. The Engineering and Development Plan defines the requirements for managing the engineering effort within this framework and further specifies requirements germane to definition of the Preliminary Test Plan, Operations Plan, and Logistics and Maintenance Plan. The Preliminary Test Plan covers ground and flight test requirements leading to achievement of operational status at which point phasing to the Operations Plan occurs. The Logistics and Maintenance Plan provides the requirements for support of both the test and operational phases. The Facility Utilization and Manufacturing Plan draws on the planning in all other areas to define total program facilities requirements. Finally, the Cost and Schedule Estimates Plan provides the fiscal requirements for fulfilling the overall program requirements covered in the six basic plans as well as providing the overall schedule framework for the program.

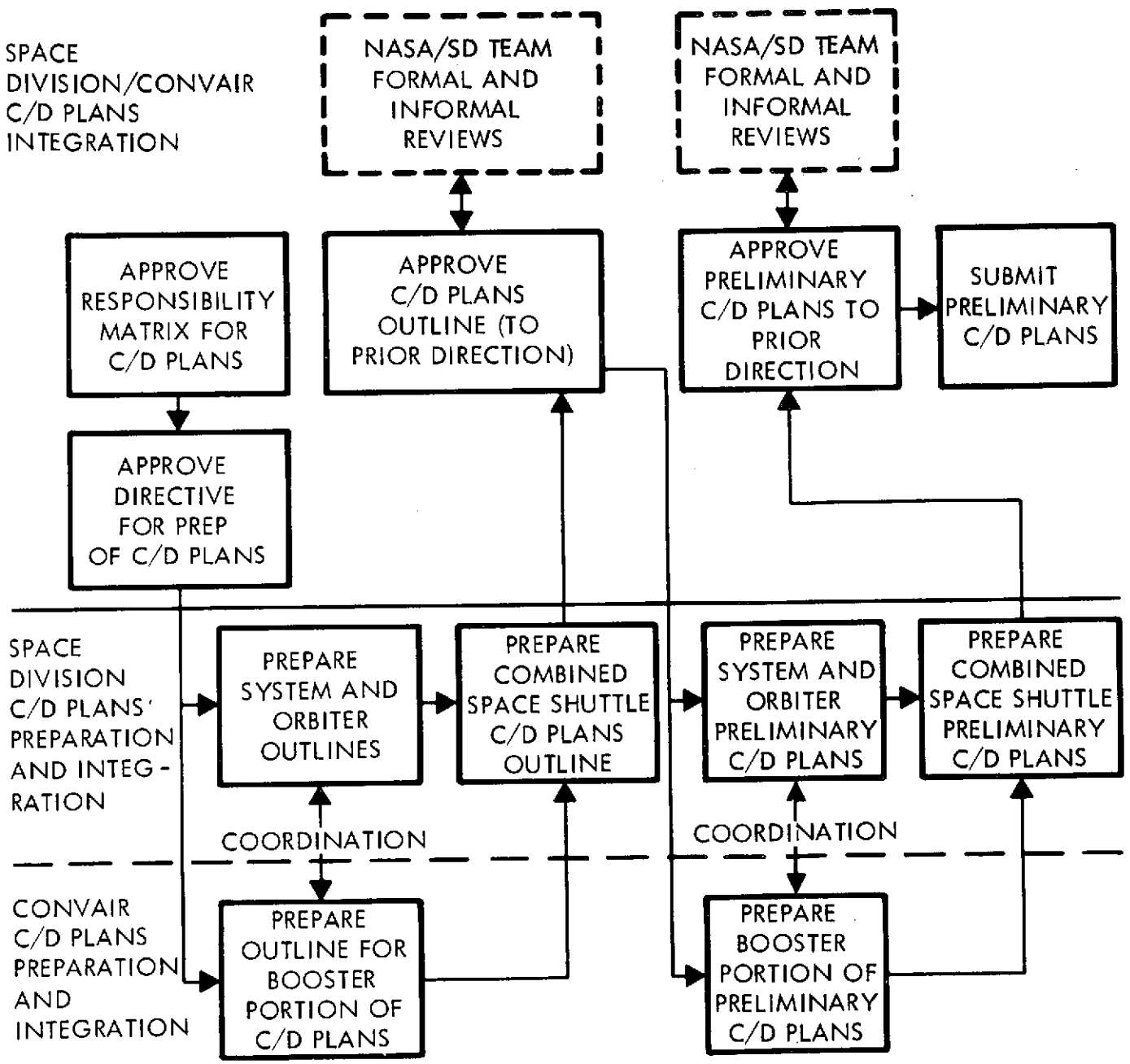

Figure 2-1. Phase C/D Plans Integration

3.0 PLANS SUMMARY

As applicable, the plans have been formatted to allow separation of the shuttle, orbiter, and booster requirements. Figure 3-1 is a summary of the individual plan contents. All plans do not have separate volumes for each element; e.g., the management requirements for the Space Shuttle Program are the same as for the orbiter and booster, whereas the test plan requires not only identity of shuttle (mated) requirements but orbiter and booster, as well as separate support equipment and software requirements.

3.1 PROGRAM MANAGEMENT PLAN

The Program Management Plan defines the requirements for managing the Phase C/D Space Shuttle Program. These management systems are intended to provide management personnel the information and visibility needed to effectively meet program requirements tailored to the Space Shuttle Program. These requirements will permit potential contractors to apply systems best suited to their own organizations, personnel, and experience.

The plan has been structured to logically sequence and identify requirements for fulfilling the essential program management activities. The program organization requirements are covered first, followed by control of program cost, schedule, and technical performance. Next are sections dealing with management of interfaces between the contractor and outside organizations.

The special management disciplines such as configuration management, data management, maintainability management, quality assurance management, and system safety management are discussed. The requirements for responsibilities and activities of these disciplines across program organizational lines are presented.

A shuttle program integration section describes the integration activities required in specific integration areas such as the shuttle system, the orbiter/booster systems, support equipment, vehicle ground flight test programs, integration with payloads, etc.

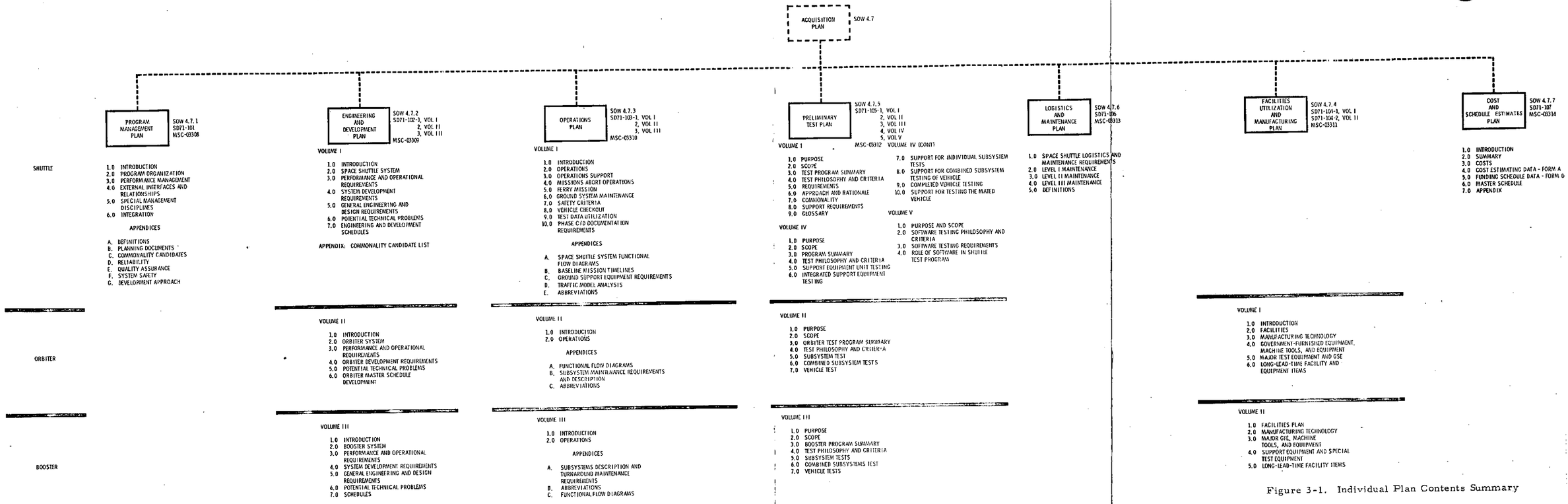

Figure 3-1. Individual Plan Contents Summary

Finally, a series of appendices encompass the development approach which was applied in determining the management requirements and related activities, the definitions used in the formulation of performance management requirements, and the requirements for planning documents, commonality, reliability, quality assurance, and safety.

3.2 ENGINEERING AND DEVELOPMENT PLAN

The purpose of the Engineering and Development Plan is to define the requirements for the design, development, and certification of the space shuttle system. The shuttle system is segregated into major elements. Requirements and performance criteria as they pertain to development logic, engineering management, subsystem identification, and engineering disciplines are discussed. The plan provides the framework for the design of the shuttle system during the Phase C/D period. It is divided into three volumes, as follows.

Volume I defines the space shuttle system engineering planning requirements for development and summarizes the planning requirements for the development of the orbiter and booster systems. Performance criteria are specified, and design requirements for major systems are established based on the performance criteria and mission constraints. Design certification requirements are specified at the program level, and guidelines are established at the system level. Integration activities associated with shuttle system development are defined, and the approach required for interface control is specified.

Volumes II and III define the engineering planning requirements in detail for the development of the orbiter system and the booster system including support equipment. Orbiter/booster system performance criteria are specified, and design requirements are established based on performance criteria and mission constraints. Orbiter/booster engineering and development functions and design certification and integration requirements are identified at the system level. The combination of Volumes I and II defines the requirements for development of an orbiter system. The combination of Volumes I and III defines the requirements for development of the booster system.

3.3 OPERATIONS PLAN

The objective of this document is to describe the tasks, constraints, and associated requirements necessary for the ground and flight operation of the space shuttle system.

This document provides a description of the operational activities and requirements derived from the analysis of both the flight and ground operations of the space shuttle. The program requirements necessary to conduct the booster and orbiter through a complete mission cycle are discussed.

The operations plan addresses those mission activities following completion of the flight qualification phase of the program. All necessary techniques are considered verified and all subsystems qualified prior to entering this operational phase. However, throughout this plan, differences of technique and requirements for flight test are identified.

The operational cycle begins with the acceptance of the vehicle by ground operations personnel following either termination of acceptance firing or after completion of a launch mission. The vehicles are first safed, turnaround maintenance is completed, checkout procedures are conducted, and the particular payload is installed. The two vehicles are then mated into the launch configuration, moved to the launch pad, and the countdown for launch is completed.

The flight phase begins with mated ascent and is completed, after landing, by the flight crew turning the vehicle over to ground personnel in the safing area. Ferry missions from site to site and the various mission aborts are discussed in separate sections of the plan.

The Operations Plan is presented in three volumes as follows:

Volume I is a detailed discussion of tasks required for processing of the space shuttle vehicle from orbiter and booster mating through vehicle staging during flight. Tasks that are primarily single-element (booster or orbiter) are covered in sufficient detail to provide continuity. In addition, Volume I contains a description of checkout capability, operations support, abort operations, ground system maintenance, and safety criteria.

Volume II details the tasks peculiar to orbiter operations from launch through postlanding and maintenance. General treatment is given those activities involving mated ground operations to assure continuity. A detailed description of mated and orbiter flight operations is included.

Volume III details the tasks peculiar to booster operations from launch through postlanding and maintenance. General treatment is given those activities involving mated ground operations to assure continuity. A description of mated and booster flight operations is included.

3.4 PRELIMINARY TEST PLAN

The Preliminary Test Plan, divided into five volumes, encompasses the definition of requirements and approach to all levels of testing from engineering design development through the acceptance of the production vehicle, including qualification and mission demonstration. In addition to vehicle testing, support equipment design development, qualification and acceptance testing, installation checkout, and integration of the support equipment with site facilities and shuttle vehicles are also covered. Software development and validation will parallel hardware testing and are integrated into the Test Program. This plan relates the tests to the test requirements delineated in the space shuttle system and end-item specifications and establishes test flows and schedules.

The Preliminary Test Plan was formatted for easy subdivision into a test plan tree, paralleling that of the specification tree. All shuttle system level mated testing will be found in Volume I; Orbiter Testing, Volume II; Booster Testing, Volume III; Support Equipment Testing, Volume IV; and Software Testing, Volume V. Test information related to each subsystem has been identified by subsystem within each volume, as applicable.

The operational missions/flight test program overlap is a significant item for the development of the shuttle system. Many operational objectives will be satisfied during the flight test program, and final flight test objectives will be fulfilled during the early phases of the operational program. The scope of the Preliminary Test Plan, as it relates to the Operations Plan in the area of mated vehicle launches, is as follows: All flight test objectives satisfied by either the flight test program or operational missions are covered in the Preliminary Test Plan. All operational mission objectives satisfied during operational missions or the flight test program are covered in the Operations Plan. Turnaround activities between test flights are not included in the Preliminary Test Plan, but are presented in the Operations Plan to demonstrate program turnaround requirements.

3.5 FACILITIES UTILIZATION AND MANUFACTURING PLAN

This plan, divided into orbiter and booster specific volumes, encompasses for each vehicle the definition of major new facilities and major Government-owned facilities and the identification of the major manufacturing problems and their solutions. The combined booster/orbiter operations facilities section is common to both volumes. In developing this plan, emphasis was placed upon maximum utilization of existing national resources, economical acquisition of new facilities, and analysis of potential manufacturing problems.

The facilities section of each document is organized by the major divisions of effort and includes a summary of studies conducted to identify site locations, major Government-owned facilities required, major new facilities planned, and major equipment required. Where the need for new facilities was indicated, alternative approaches were explored to assure minimum impact upon program cost and schedule objectives.

Recommendations are given for all shuttle system element site locations, and the selection rationale is explained. Utilization of the recommended sites is described in detail, including environmental data, special facilities and equipment, and special handling capability.

Major equipment to be furnished by the Government is listed. Major machine tools, fabrication tools, and major equipment for testing and operations are included. In addition, estimated costs and proposed locations for checkout, development testing, laboratory testing, and operations are given, and long-lead time facilities and equipment requirements are indicated.

The Manufacturing Technology section identifies major manufacturing problems, manufacturing concerns, and items with the potential for causing substantial program impact. Identification of manufacturing problems is based on a comprehensive study of the manufacturing process during which a manufacturing flow and build plan was developed. The manufacturing problems were analyzed by the trade study technique to develop the optimum solutions. From this preplanning, manufacturing requirements for special testing, material and personnel handling, parts-protection, and support equipment have been determined.

3.6 LOGISTICS AND MAINTENANCE PLAN

This plan defines and establishes the requirements for a maintenance planning and maintenance support system necessary to conduct flight test and operational phases of the Space Shuttle Program. The plan relates to the requirements established in the Preliminary Test Plan and the Operations Plan.

The plan provides a description of maintenance activities required to continue the operating condition and the turnaround availability of the orbiter, booster, and related support equipment. Also identified are supporting elements required to conduct the maintenance activities and detail requirements on which to develop the support systems. The plan is presented in one volume, comprising four sections as follows.

Section 1 identifies the requirements for maintenance and logistics support elements and defines major activities to be accomplished in developing each element.

Section 2 identifies the requirements for support resources necessary for the conduct of equipment replacement maintenance to the subsystems of the orbiter, booster, and fixed support equipment.

Section 3 identifies the requirements for support resources necessary for the conduct of equipment repair maintenance to line replaceable units of the orbiter, booster, and mobile support equipment.

Section 4 identifies requirements for support resources necessary to conduct extensive rework maintenance at any equipment assembly level of the orbiter, booster, and items of support equipment.

3.7 COST AND SCHEDULE ESTIMATES PLAN

The purpose of this document is to furnish NASA with scheduling, funding, and costing data that will be a guide for use in arriving at realistic costs for a Phase C/D Space Shuttle Program. The plan has been arranged in appropriate sections to facilitate review and subsequent reference. An appendix is included to provide a glossary of terms and other data used.

The cost, schedule, and funding data, methodology, and rationale are displayed at level 5 of the WBS with summaries for levels 4 and 3. Programmatic and specific element, system, and subsystem ground rules are included to further define costs included or excluded. The plan displays all cost in terms of nonrecurring (DDT&E), recurring (production), and recurring (operations).

The plan includes Cost Estimating Data Form A and Schedule Data Form D in accordance with Cost and Schedule Specification MF003 of the Statement of Work.